5.0 SUMMARY OF SITE CHARACTERISTICS

Six media were evaluated in the RI for the Offpost Study Area: groundwater, soil, surface water, sediment, air, and biota. Each medium was evaluated in the Offpost EA with respect to (1) the nature and extent of contamination and (2) potential exposure pathways and associated risk to humans and the environment. A map delineating the boundaries of the Offpost Study Area is included as Figure 1.1. The site characteristics are more fully described in the Offpost Operable Unit Remedial Investigation Report (ESE, 1988a) and the Offpost Operable Unit Remedial Investigation, Final Addendum (HLA, 1992b).

5.1 Sources of Contamination

As described in Section 2.1, chemicals were introduced to the RMA environment primarily by the burial or surface disposal of solid wastes, discharge of wastewater to basins, and leakage of wastewater and industrial fluid from chemical and sanitary sewer systems. Chemicals migrated to the Offpost Study Area primarily by shallow (i.e., shallow or unconfined) groundwater and airborne pathways. Contaminant transport in the shallow or unconfined groundwater has been controlled by construction of the boundary containment systems and improvements to these systems (completed as IRAs). Offpost Study Area surface water was contaminated primarily by the natural interaction with offpost groundwater. Offpost Study Area surface soil was contaminated by the deposition of airborne contaminants, non-RMA-related agricultural application of pesticides, and irrigation practices. Agricultural sources of pesticides are discussed in the Final Offpost RI Addendum (HLA, 1992b). Air monitoring data indicate that the air pathway does not contribute to human exposure.

5.2 Nature of Contamination

Several chemicals of concern (COCs) are present in offpost groundwater, surface water, sediment, and soil (see Tables 6. 1 through 6.4). COCs include organochlorine pesticides (OCPs), halogenated aliphatics, aromatic hydrocarbons, diisopropylmethyl phosphonate (DIMP), sulfur-containing organic chemicals, arsenic, and dissolved salts.

The COCs exhibit great variability in their mobility and persistence in environmental media. OCPs are less mobile than the other COCs and more persistent, tending to associate with soil and sediment and to biomagnify in the food chain. Most of the remaining COCs are mobile in groundwater, and the aromatics and aliphatics are volatile in surface water. The fate properties of the COCs tend to determine their distribution in the Offpost Study Area. All COCs were detected in groundwater, but the more mobile chemicals are more widely distributed. The OCPs are virtually the only COCs detected at concentrations above background levels in soil and sediment. The volatile compounds were not significantly elevated above background levels in surface water and, in fact, were rarely detected.

5.3 Contamination Migration Pathways

The RI programs have shown that there are three groundwater migration pathways in the Offpost Study Area. These migration pathways (shown in Figure 5.1) are referred to as the northern paleochannel, due north of the RMA north boundary; the First Creek paleochannel, paralleling First Creek to the northwest from the RMA north boundary; and the northwest paleochannel, northwest of the RMA northwest boundary. The northern and First Creek paleochannels compose the North Plume Group, and the northwest paleochannel composes the Northwest Plume Group. These two plume groups encompass an area of approximately 590 acres in the Offpost Study Area. The alluvial flow system transports most of the contamination in paleochannels characterized by coarser sediment. Some of the groundwater traveling through the First Creek paleochannel discharges to First Creek, probably seasonally, resulting in transfer of contaminants to First Creek.

Figure 5.1 also presents the offpost surface-water features. The primary surface-water pathway is First Creek, which flows northwest from the northern RMA boundary. First Creek empties into O'Brian Canal, which flows northeast and empties into Barr Lake. Burlington Ditch, which parallels O'Brian Canal, also flows into Barr Lake. The majority of the surface-water contamination is located in First Creek, with some contamination in O'Brian Canal downstream of the confluence with First

Creek and Burlington Ditch. Barr Lake has not been shown to be contaminated with RMA-related chemicals greater than naturally occurring background levels.

In addition to the contaminant migration pathways of groundwater and surface water, prevailing winds transport onpost surface soil to offpost locations, and sediment provides a potential contaminant source for aquatic species.

5.4 Extent of Contamination

Varying levels of contamination exist in the following five media in the Offpost OU: groundwater, surface water, stream-bottom sediment, surface and subsurface soil, and biota. More detailed discussions of the offpost contaminant concentrations, along with figures showing concentration distributions are found in Sections 3.0, 4.0, 5.0, and 6.0 of the Final Offpost RI Addendum (HLA, 1992b).

5.4.1 Groundwater

Table 6 .1 presents the groundwater COCs and the exposure point concentrations used in the Endangerment Assessment. The most widespread RMA-related groundwater COC in the Offpost Study Area is DIMP, which is present in the UFS at varying concentrations in a band from the west end of the NWBCS to the east end of the NBCS, and from the RMA north and northwest boundaries to the South Platte River. The other primary contaminants present in the offpost UFS are chloroform, chlorobenzene, trichloroethene, tetrachloroethene, dibromochloropropane (DBCP), dieldrin, endrin, dicyclopentadiene (DCPD), arsenic, chloride, fluoride and sulfate.

The highest concentrations of DIMP observed in the past three years are in the First Creek paleochannel. Concentrations of DIMP are lower in the northern paleochannel and lower still in the northwestern paleochannel. The maximum concentrations of DIMP in the Offpost Study Area have decreased by approximately 50 percent over the past 10 years. The NBCS is currently operating and has been operated in the past to remove multiple contaminants. DIMP concentrations are being

reduced to less than 8 ppb. Cut-off of groundwater contaminants at the NBCS and recharge of the treated groundwater has resulted in the observed decrease in DIMP concentrations specifically, as well as the other contaminants found offpost.

The highest contaminant levels downgradient from the NBCS occur upgradient of the O'Brian Canal. Certain volatile compounds such as chlorobenzene, chloroform, trichloroethene, and DBCP have been detected at low concentrations downgradient from the canals, but well-defined plumes do not exist in this area and these detections may be anomalous. Semivolatile organic compounds such as dieldrin and other OCPs are present almost exclusively upgradient of the canals. Maximum concentrations of the OCPs (i.e., aldrin, isodrin, chlordane, 2,2-bis[p-chlorophenyl] -1,1 -dichloroethene[DDE], and 2,2-bis[p-chlorophenyl]-1,1 ,1-trichloroethane[DDT]) generally occur in the First Creek paleochannel within 500 to 1000 feet of the NBCS. Only sporadic and isolated occurrences of OCPs are observed northwest of the RMA northwestern boundary.

Contaminants found downgradient from the NWBCS are primarily chlorobenzene, chloroform, DIMP, and dieldrin. The highest concentrations of chloroform occur downgradient of the RMA boundary. Detections of chlorobenzene near the NWBCS may be anomalous. In 1989, semivolatile compounds such as dieldrin and possibly DIMP appeared to have bypassed the NWBCS at the northeast and southwest ends. Subsequently, the NWBCS IRA was initiated that included improvements and operational changes to correct the bypass. Recent modifications to the NBCS and NWBCS, in addition to the remedial action selected in this ROD, are expected to further reduce contaminant levels downgradient of the RMA boundaries.

5.4.2 Surface Water

Table 6.2 presents the surface water COCs and the exposure point concentrations used in the Endangerment Assessment. The principal organic compounds identified in Offpost Study Area surface-water samples are DIMP and dieldrin. In general, the highest concentrations of the organic and inorganic analytes were detected in First Creek. DIMP concentrations in First Creek were highest

in the area 100 to 200 feet upstream of O'Brian Canal where groundwater discharges to First Creek. DIMP was not detected in Burlington Ditch or O'Brian Canal upstream of the confluence with First Creek. DIMP was detected in Barr Lake in only one of 20 samples collected from 1985 to 1990 and was not detected in the duplicate sample collected at the same time. This one detection is anomalous and not considered representative of conditions at Barr Lake.

The highest concentrations of arsenic were detected in First Creek near the northern RMA boundary. These detections are likely associated with discharge from the onpost sewage treatment plant. Mercury and arsenic were detected in surface water in O'Brian Canal upstream of the confluence with First Creek, suggesting that sources of these contaminants other than RMA probably exist. Some contaminants identified in O'Brian Canal and Burlington Ditch may originate from the diversion of treated sewage effluent from Denver.

5.4.3 Stream-bottom Sediments

Table 6.3 presents the sediment COCs and the exposure point concentrations used in the Endangerment Assessment. The most commonly detected contaminants in stream-bottom sediment in the Offpost Study Area were dieldrin, arsenic, and mercury. The highest concentration of dieldrin was found in First Creek immediately north of the northern RMA boundary. Additional contaminants were detected in O'Brian Canal and Burlington Ditch upstream of the confluence with First Creek, suggesting that sources of these contaminants other than RMA probably exist such as diversion of treated sewage effluent from Denver.

5.4.4 Surface and Subsurface Soil

Table 6.4 presents the soil COCs and the exposure point concentrations used in the Endangerment Assessment. Approximately 100 soil samples were collected as part of the RI Addendum investigation and were analyzed for OCPs, arsenic, and mercury. Dieldrin was the most frequently detected OCP (in approximately 90 percent of the samples) with a maximum concentration located approxi-

mately 100 to 200 feet north of the northern RMA boundary. DDT, DDE, aldrin, endrin, and chlordane were detected less frequently.

The distribution of OCPs in Offpost Study Area soil appears to correlate with the dominant wind patterns at RMA. The greatest number and highest contaminant concentrations are observed in samples collected immediately north of the northern RMA boundary, consistent with the prevalent wind direction of south to north. Isolated elevated concentrations of OCPs observed between the northern RMA boundary and O'Brian Canal may be the result of local residential and/or commercial use of pesticides and not related to migration from RMA. Anomalously high concentrations of dieldrin, DDE, and DDT were also detected approximately 1.5 miles northwest of RMA. These detections are considered to be agricultural-related and not RMA-related because the area is currently and has historically been a farming community.

The uneven distribution of arsenic and mercury in Offpost Study Area surface soil suggests that the occurrence of these inorganic contaminants is not related to RMA activities.

5.4.5 Biota

The RI Addendum biota monitoring program provided additional data to assess the potential impacts on plants and animals in the Offpost Study Area. During the RI Addendum study, biota samples were analyzed for aldrin, dieldrin, endrin, DDE, DDT, DBCP, arsenic, and mercury. Dieldrin, the contaminant most often found in Offpost Study Area biota (36 percent of samples), was detected in cattle, chicken, fish, earthworm, deer mouse, prairie dog, and pheasant samples. Arsenic and mercury were detected less frequently (1 9 and 14 percent, respectively). DDE was detected only once, and aldrin, endrin, DDT, and DBCP were not detected in any biota samples from the Offpost Study Area. Contaminants identified in the Offpost Study Area biota survey are similar to those found onpost, although the concentrations detected in the Offpost Study Area biota are considerably lower than concentrations detected in the onpost biota.

The Offpost Study Area is known to contain suitable habitat for endangered species such as the bald eagle. A nesting pair of eagles was identified during offpost assessment activities. Contaminants (mercury, dieldrin, and DDE) were detected in a bald eagle egg collected in 1988 from a nest at Barr Lake. According to the U.S. Fish and Wildlife Service, the concentrations of these contaminants were typical of bald eagle egg contamination throughout the United States.

5.5 Potential Routes of Human and Environmental Exposure

Based on the current land uses in the Offpost Study Area, a review of local city and county planning and zoning ordinances, and consultation with local planning authorities, three primary land uses were considered in estimating the risks to human health. These land uses are urban residential, rural residential, and commercial and industrial. The exposure routes and pathways considered for the Offpost Study Area include the following:

- Ingestion of groundwater
- Ingestion of soil
- Ingestion of sediment
- Ingestion of vegetables
- Ingestion of dairy products
- Ingestion of eggs
- Ingestion of meat
- Ingestion of surface water
- Inhalation of volatile chemicals in groundwater
- Inhalation of dust
- Dermal contact with soil
- Dermal contact with sediment
- Dermal contact with surface water
- Dermal contact with groundwater